Digital Signal Processing Course Definition Form

1. Basic Information:

Course Name	Digital Signal Processing
Course ID	CEE203
Contact Hours (Registered Sessions)	30
Contact Hours (Synchronized Sessions)	18
Mid Term Exam	None
Exam	1.5
Registered Sessions Work Load	30
Synchronized Session Work Load	18
Credit Hours	5

2. Pre-Requisites:

Course	ID
Signals and systems	CEE203
Mathematical Analysis	GMA102

3. Course General Objectives:

This course aims to introduce the basics of Digital Signal Processing using the mathematical tools presented in Signal and Systems courses. We review some of these tools with additional new concepts to go more deeply in analyzing digital systems. We present the basic digital networks used to implement discrete systems including the various structures of FIR and IIR digital filters. The effect of coefficients quantization and finite precision arithmetic on the performance of LTI systems is also presented. We also present the main methods used in digital filters design. A special interest is given to the interpretation of the DFT of sinusoidal signals to understand the limits of this tool in spectral analysis. We conclude by introducing the discrete cosine transform which is used in many applications as in JPEG image compression.

4. Intended Learning Outcomes (ILO):

Code	Intended Learning Outcomes
ILO1	Describe discrete-time signals and its properties.
ILO2	Describe discrete-time systems and its properties.
ILO3	Apply Fourier Transform to analyze for discrete-time systems.
ILO4	Understand the Sampling theorem and the quantization operation.
ILO5	Review the Z-transform and its properties.
ILO6	Apply the Z-transform to analyze discrete systems.
ILO7	Describe the digital networks and main methods to implement discrete systems.
ILO8	Understand the effect of coefficient quantization and finite precision arithmetic on the performance of discrete systems.
ILO9	Identify design methods for FIR filters.
ILO10	Identify design methods for IIR filters.
ILO11	Apply the Discrete Fourier Transform to analyze discrete signals.
ILO12	Apply the Cosine Transform and its main applications.

5. Course Syllabus (18 hours of total synchronized sessions)

- RS: Recorded Sessions; SS: Synchronized Sessions;

ILO	Course Syllabus	RS	SS	Type	Additional Notes
ILO1	Discrete-Time Signals Discrete-time signals Complex Signals Famous discrete signals Signal duration Periodic Signals Symmetric signals Transformations on signals Signal decomposition	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO2	Discrete-time systems Properties of discrete systems Linear time-invariant systems Convolution properties Difference equations	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO3	Fourier analysis for discrete systems Frequency response for LTI system Graphical representation of the frequency response Discrete-Time Fourier Transform (DTFT) Properties of DTFT Filters	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO4	Sampling and Quantization Analog to Digital conversion Sampling theorem Quantization and coding Digital to Analog conversion Changing the sampling rate	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	

ILO5	Z–Transform Definition of Z–transform Inverse Z–transform Properties of Z–transform Initial and final values theorems Z–transform for basic signals	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO6	Transform analysis of discrete systems System function Linear phase systems Minimum phase systems Feedback systems Practical signal reconstruction	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO7	Implementation of discrete systems Digital networks Structures for FIR systems Structures for IIR systems	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO8	Finite precision effects on digital filters Quantization error in fixed point systems Coefficients Quantization Round–off error Pairing and ordering Overflow	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO9	Design of FIR filters Filter specifications FIR Filter design using windows Frequency sampling method Equiripple linear phase filters Alternation theorem	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	

ILO10	Design of IIR filters Prototypes of analog lowpass filter IIR filter design from analog filter Frequency transformations Least squares error methods	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO11	Discrete Fourier Transform DFT Discrete Fourier Transform DFT DFT analysis of sinusoidal signals Time-dependent Fourier transform	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	
ILO12	Discrete Cosine transform Definition of DCT Relationship between DFT and DCT-I Relationship between DFT and DCT-I Power compacting property of DCT-II Applications of DCT	2.5	1.5	Exercises Assignments Seminars Projects Practices Others	

6. Assessment Criteria (Related to ILOs)

ISC	Interactive Synchronized Collaboration		Ex	Exams		Rpt	Reports
PF2F	Presentations and Face-to-Face Assessments		PW	Practice Work			

ILO Code	ILO	Intended Results	Assessment Type				
			ISC	PW	Ex	PF2F	Rpt
ILO1	Describe discrete-time signals and its properties.		X		X		
ILO2	Describe discrete-time systems and its properties.		X		X		
ILO3	Apply Fourier Transform to analyze for discrete-time systems.		X		X		
ILO4	Understand the Sampling theorem and the quantization operation.		X		X		
ILO5	Review the Z-transform and its properties.		X		X		
ILO6	Apply the Z-transform to analyze discrete systems.		X		X		
ILO7	Describe the digital networks and main methods to implement discrete systems.		X		X		
ILO8	Understand the effect of coefficient quantization and finite precision arithmetic on the performance of discrete systems.		X		X		
ILO9	Identify design methods for FIR filters.		X		X		

ILO10	Identify design methods for IIR filters.		X		X		
ILO11	Apply the Discrete Fourier Transform to analyze discrete signals.		X		X		
ILO12	Apply the Cosine Transform and its main applications.		X		X		

7. Practice Tools:

Tool Name	Description

8. Main References

Monson H. Hayes, "Digital Signal Processing", McGraw Hill, 1999.

9. Additional References

Alan V. Oppenheim, Ronald W. Schafer, "Discrete-Time Signal Processing", Second Edition, Prentice Hall, New Jersey, 1999.